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Geotechnical Aspects of MR&T Levee Design, Construction and Maintenance

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Not an MR&T Levee



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MR&T Levee

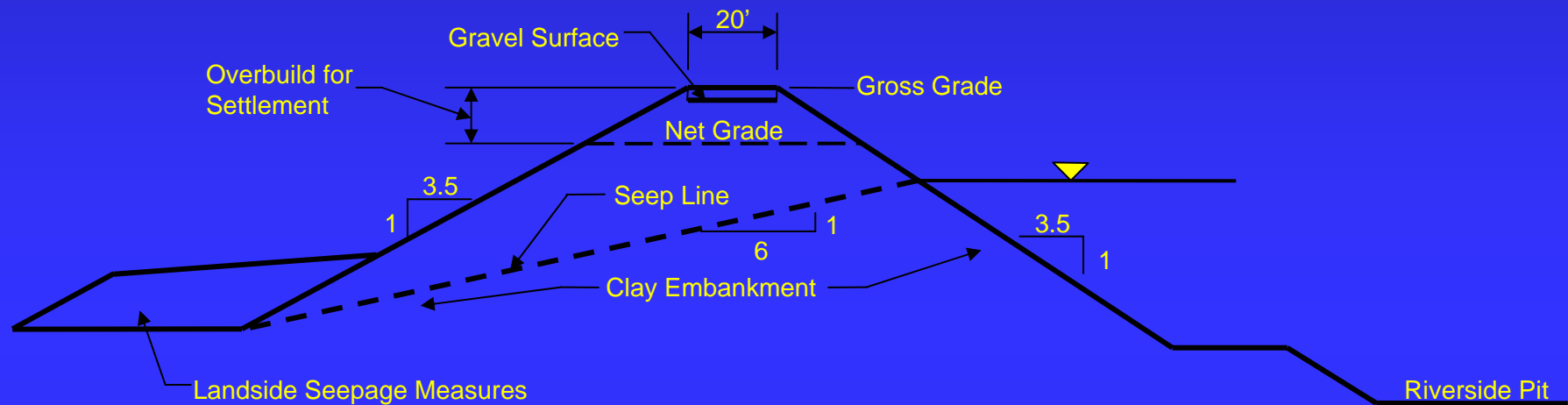


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GEOTECHNICAL DESIGN AND CONSTRUCTION OF A MR&T LEVEE



1. 20 ft. crown with gravel surface ensures adequate levee section and access during flood.
2. Minimum 1V on 3.5H slopes ensure slope stability.
3. Levee section encompasses 1V and 6H seep line.
4. Landside seepage measures protect levee toe from seepage problems.
5. Clay embankment prevents through seepage.
6. Overbuild compensates for settlement.

Note: Borings were taken, lab tests performed and slope stability, seepage and settlement analyses were performed for most levees.



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MR&T Construction Budget (MVM)



- Construction budget historically has been approximately \$15.0 million/year



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MVM Budget Focuses on Seepage Control Measures



- Riverside Blanket/Berms
- Landside Berms
- Relief Wells
- Cutoff Walls (Slurry Trenches)



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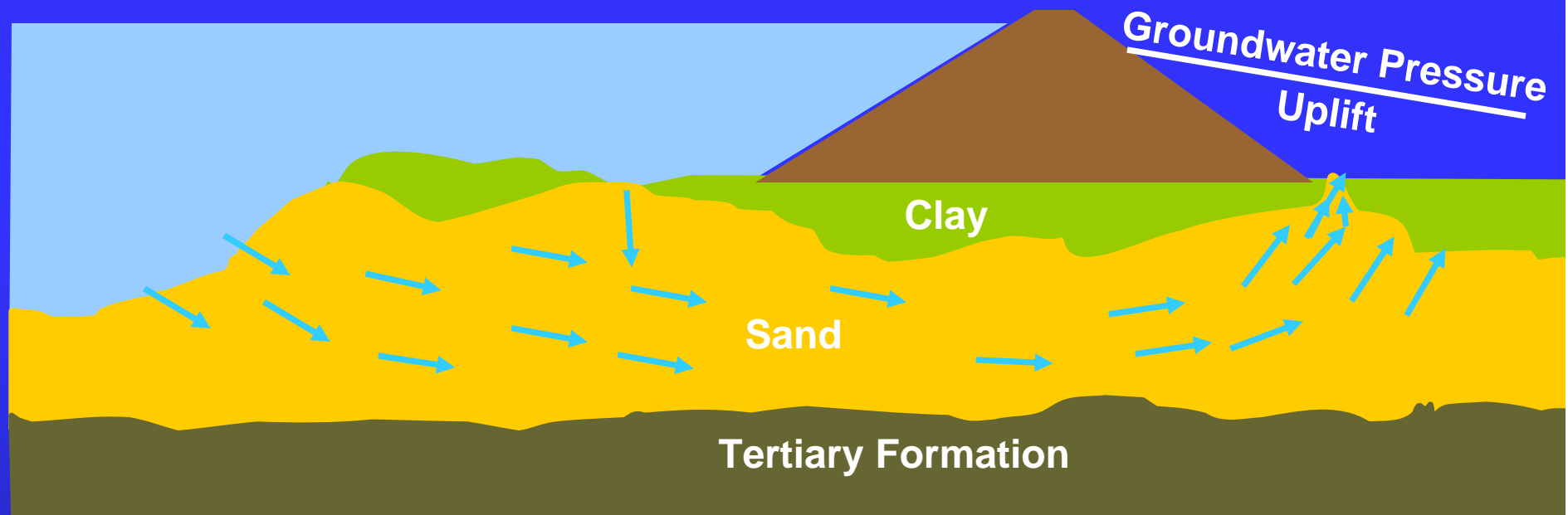
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Underseepage



RIVERSIDE

LANDSIDE



Groundwater Pressure Produces Sandboils



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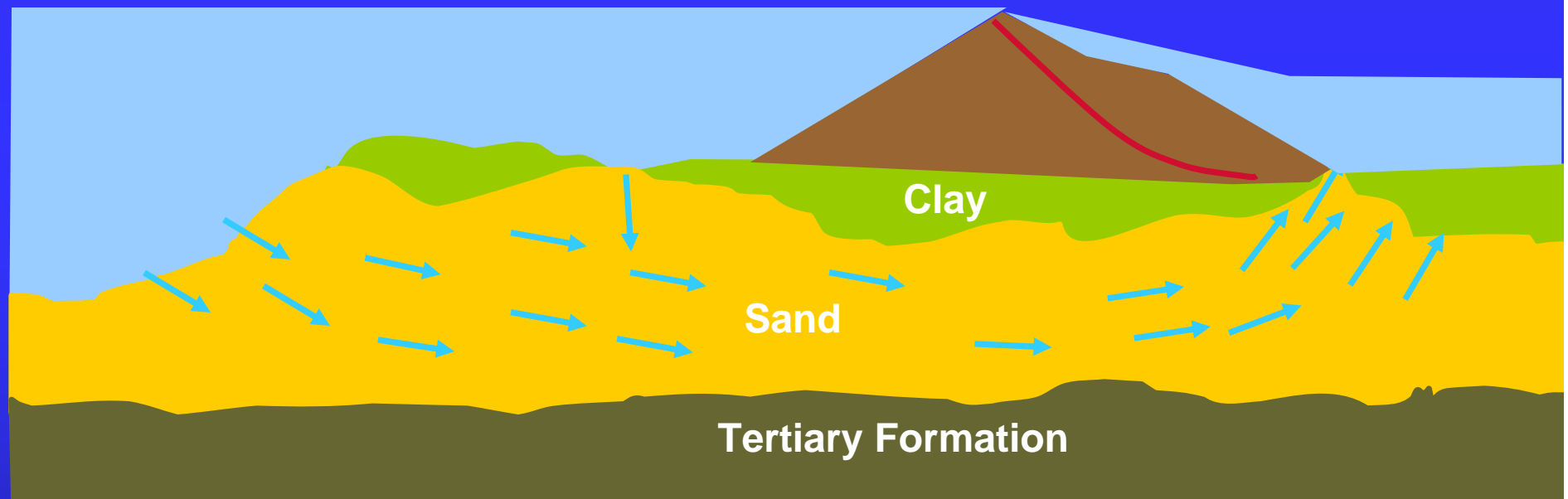


Underseepage

RIVERSIDE

Loss of Foundation
Sands = Levee Breach

LANDSIDE



Progressive Failure of Embankment Causes Breach



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Observation During Flood Events



Sand Boil



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Historic MR&T Construction Information



- Length of MR&T Levee – Approx. 630 miles
- MR&T Levee Miles Studied – Approx. 425 miles
- Seepage Measures Constructed – Approx. 310 miles
 - 1 Mile of Riverside Blanket
 - 275 Miles of Landside Berms
 - 22 miles of Relief Wells (775 wells)
 - 12 Miles of Slurry Trenches



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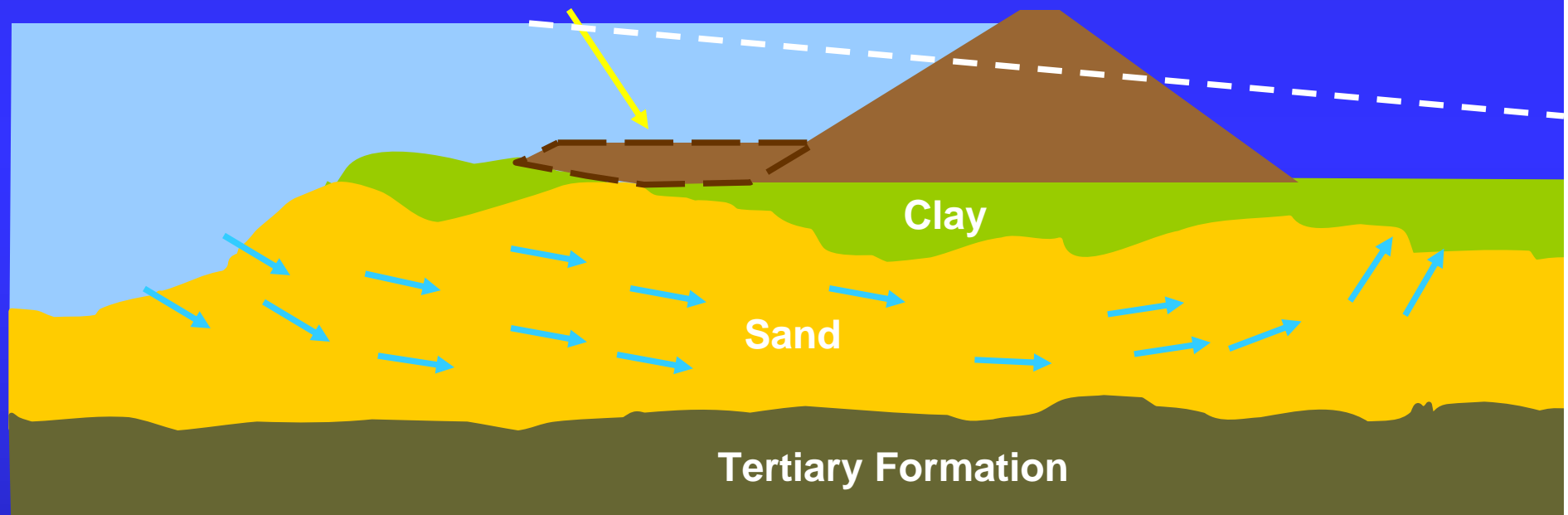
Riverside Berms



RIVERSIDE

LANDSIDE

Riverside Berms Fill Existing
Borrow Pits and Reduce Seepage
Quantities



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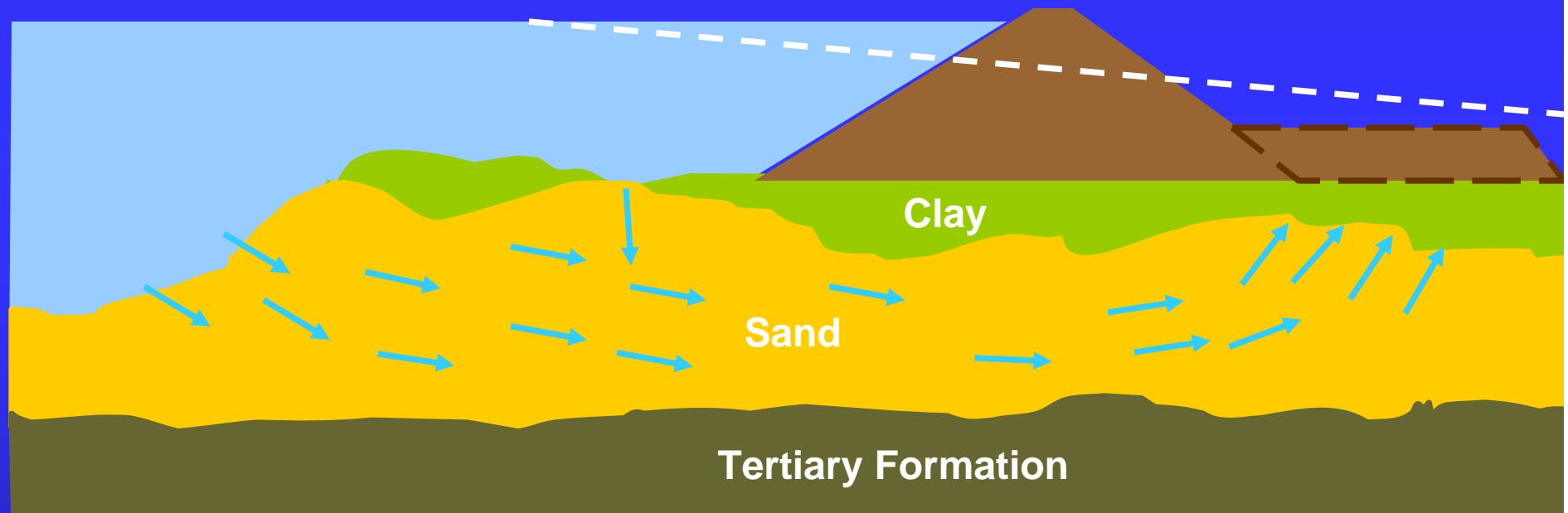
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Landside Berms

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LANDSIDE



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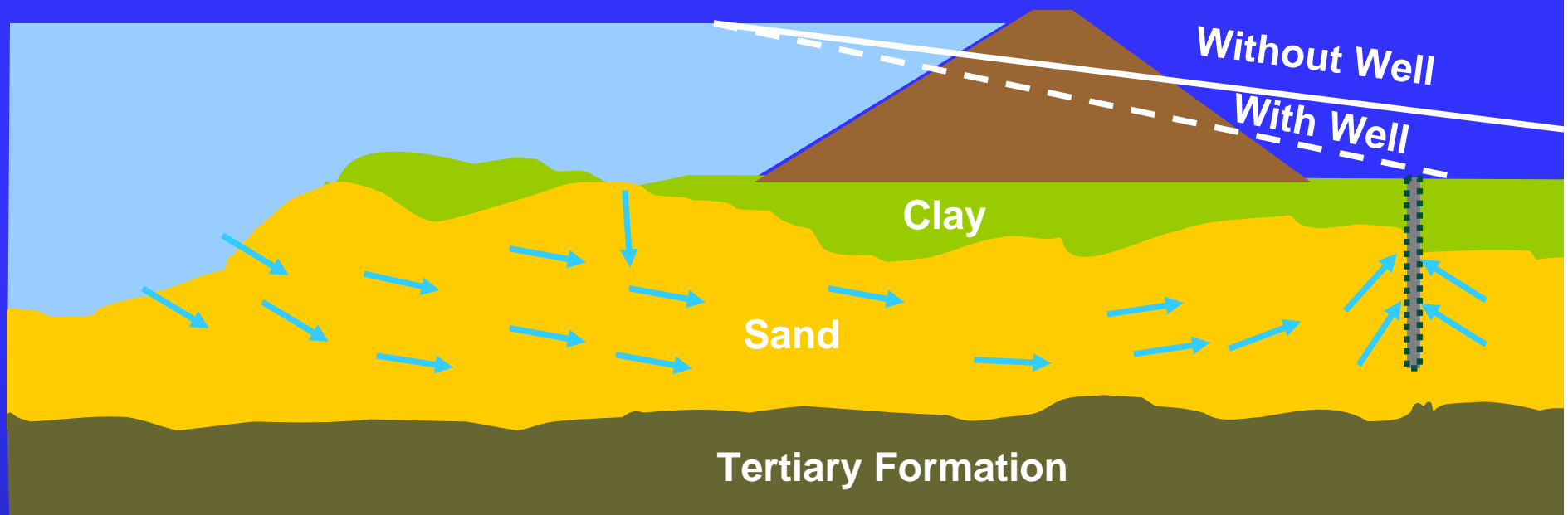
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Relief Wells

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LANDSIDE



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Pecan Point, AR - Relief Wells



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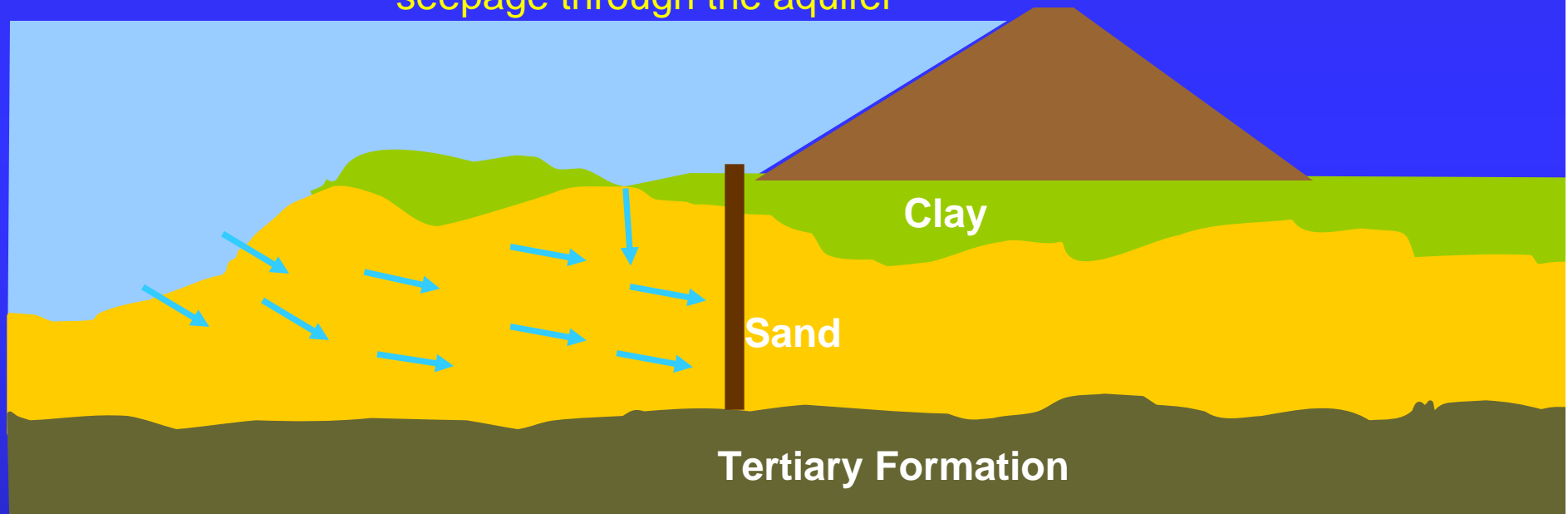


Cutoff Walls / Slurry Trenches

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LANDSIDE

Cutoff Wall reduces the quantity of
seepage through the aquifer



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Maintenance



- Local Levee Districts perform minor maintenance
- Memphis District performs major maintenance
- Memphis District Maintenance Budget
(Approx. \$4.5 mil/yr)
 - Monitor levees through robust annual routine inspections
 - Monitor levee profiles (Approx. 10 Year Intervals)
 - Ensure maintenance during floods
 - Inspect and rehabilitate relief wells
 - Slope Stabilization



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Maintenance Projects



- Slope Stabilization
 - Slope Flattening
 - Lime Treatment
 - Lime/Fly-ash Injection
 - Gravel trenches
 - Geogrid Reinforcement
 - Erosion Protection

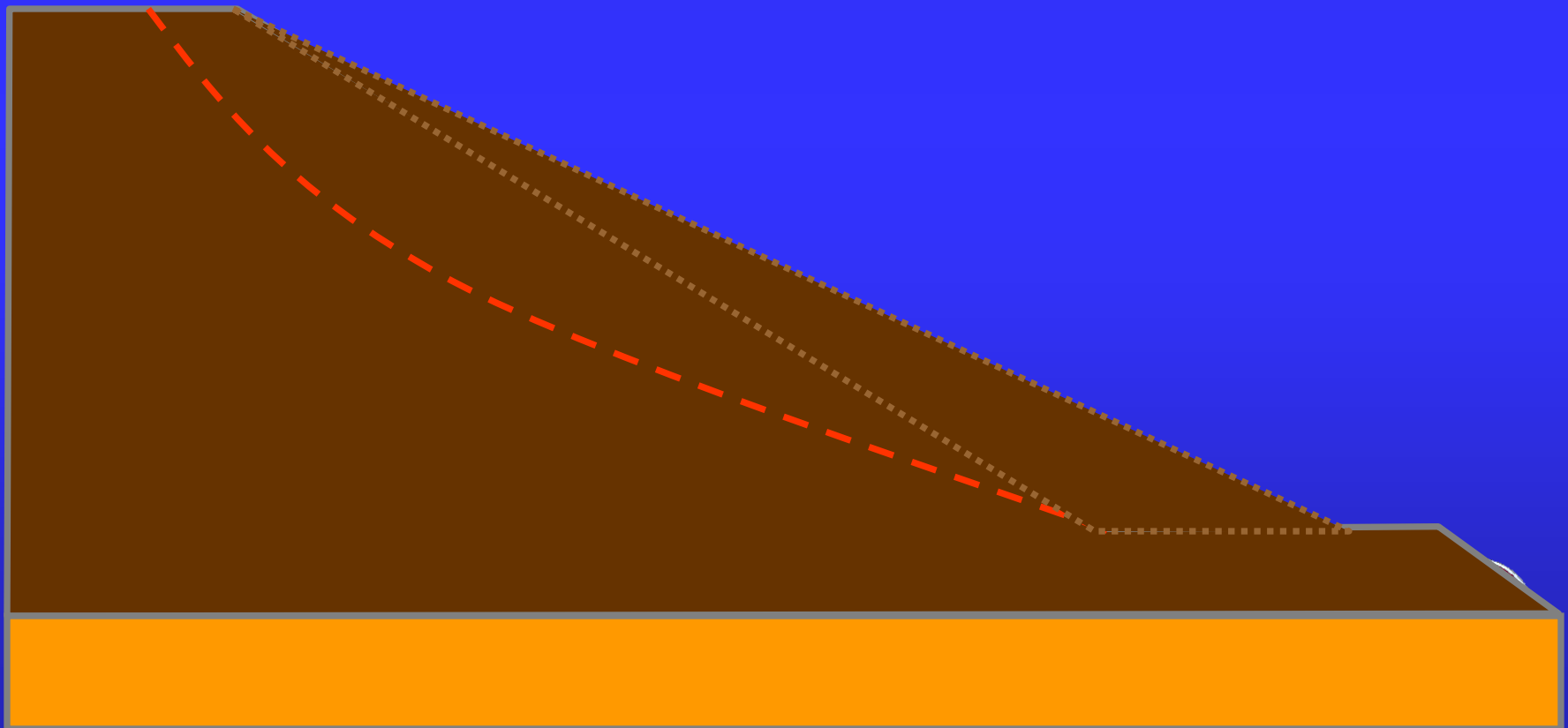


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Slope Flattening



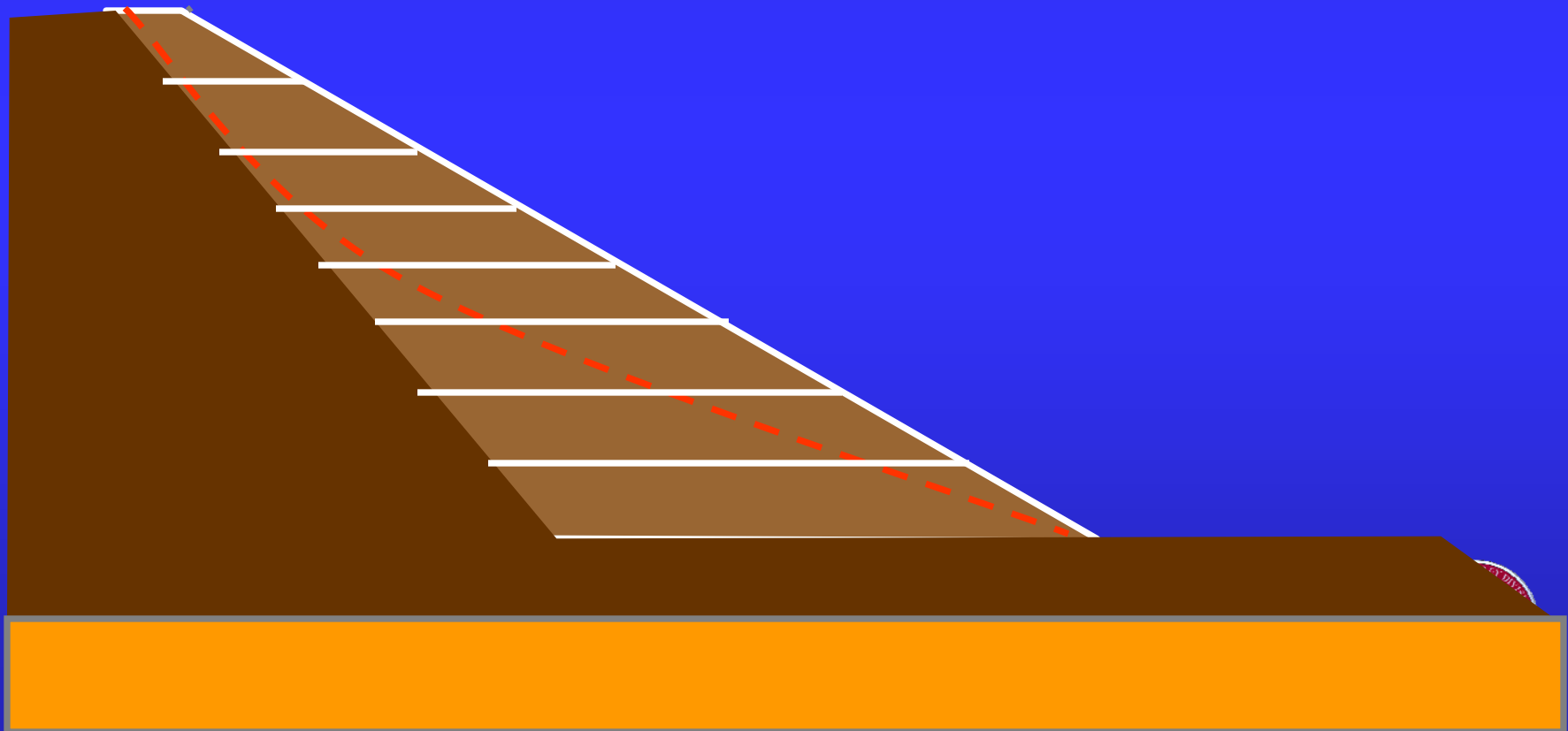


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Lime Stabilization



Lime mixed with the soil strengthens the soil





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Lime Stabilization



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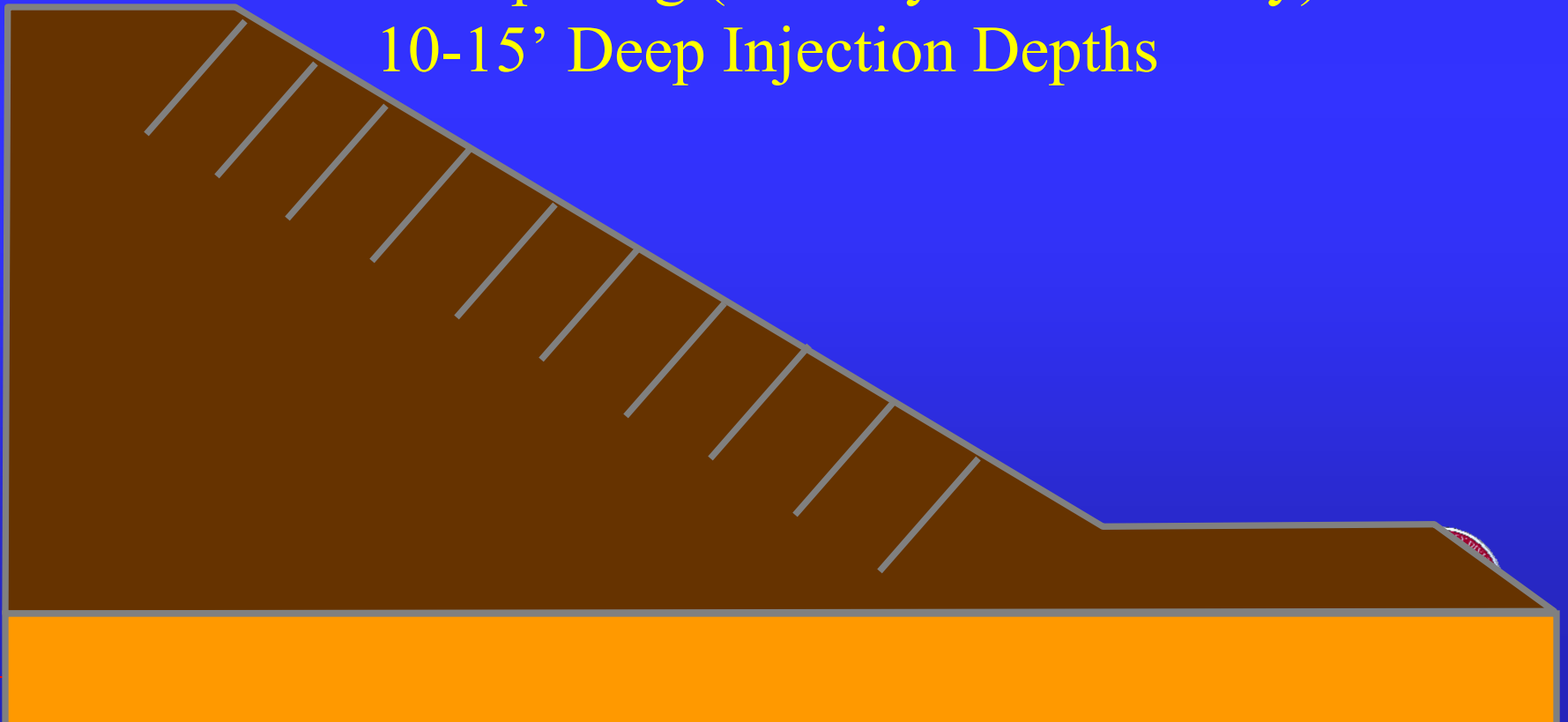
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Lime/Fly-Ash Injection



Lime/Fly-Ash Slurry fills voids and reacts with Clay minerals

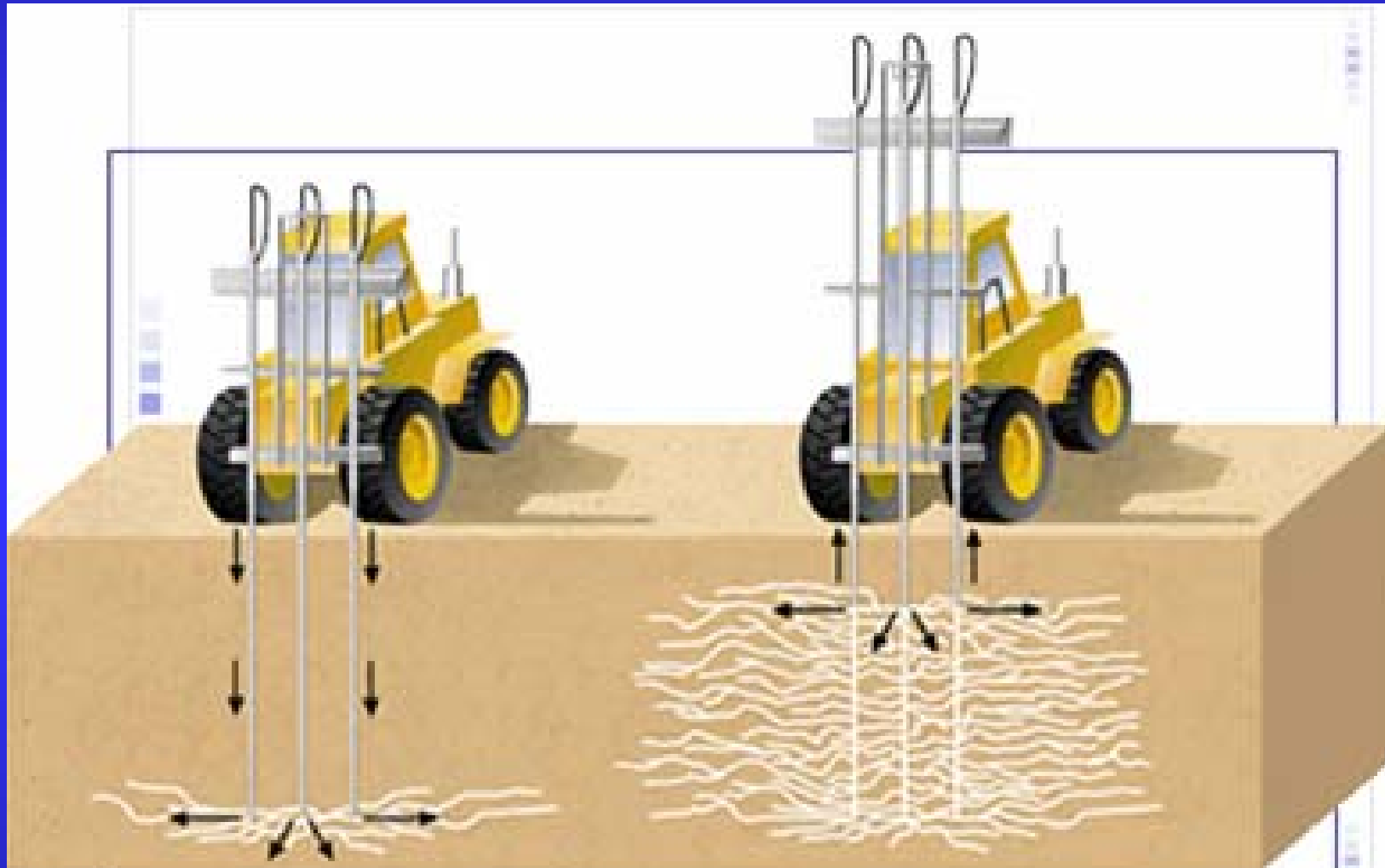
5' Center Spacing (Primary & Secondary)
10-15' Deep Injection Depths





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Lime/Fly-Ash Injection



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Lime/Fly-Ash Injection



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Gravel Trenches



Goal: Increase average strength of embankment

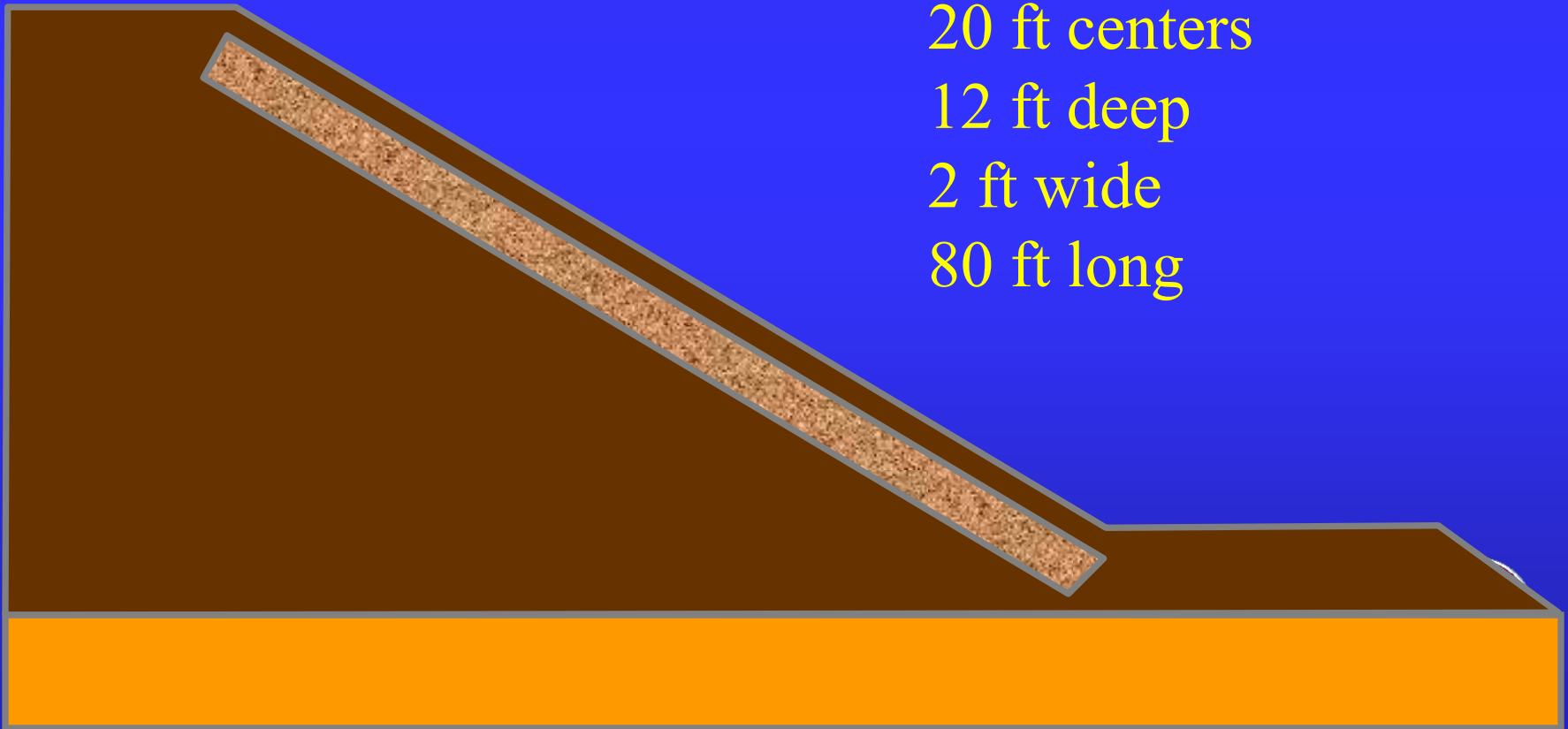
Soil $\phi'r \approx 10^\circ$; Gravel $\phi'r \approx 35^\circ$

20 ft centers

12 ft deep

2 ft wide

80 ft long





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Gravel Trenches



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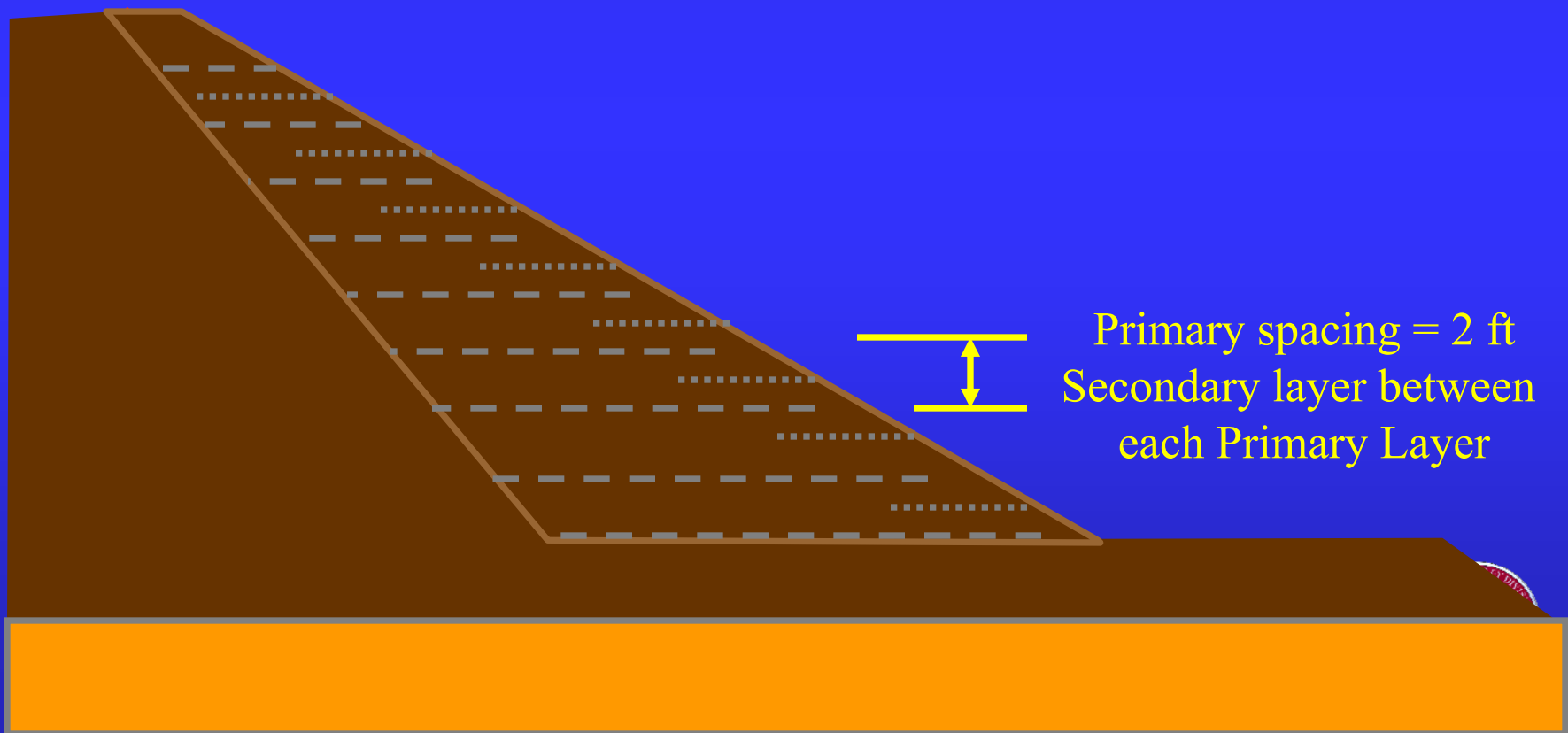


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Geogrid Reinforcement



Strain in slope mobilizes 20% to 30% of Geogrid
Tensile Strength





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Levee Slide Repair



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Geogrid Reinforcement



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Erosion Protection



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Erosion Protection



3/20/2003



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Levee Safety Program Issues



- Impacts of Trees/Vegetation on Levee Stability
- Seismic Stability of Levee
 - New Madrid Earthquake Zone
 - Draft ETL 1110-2-570 on Levee Certification, requires seismic stability analysis of a levee where PGA is greater than 0.15g
 - Seismic analysis includes liquefaction analysis, slope stability analysis, and deformation analysis
 - Capability to repair earthquake damaged levees prior to next flood event will be taken into account in the levee system certification process
- I-Wall Stability



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